A study of pasture trees and shrubbery

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(WITH THIRTEEN TEXT FIGURES)

Some years ago my attention was called to the peculiarly regular form of the thorn trees in the pastures of northeastern Ohio. These peculiar shapes are taken by the trees in response to the constant pruning to which they are subjected by the cattle. A very short study revealed the fact that other species are as characteristically affected as the thorns; this is especially true of wild apples, oaks and elms. Further, the behavior of each of the different types has features peculiar to itself. Many kinds of trees are not able to withstand the constant browsing to which they are subjected when growing in closely cropped pastures and so quickly disappear. On the other hand several species are not molested at all by the cattle. The "immunity" which is enjoyed by most nut-bearing trees seems to depend upon a taste or texture which is repugnant to the cattle. Whether or not this explanation is of wider application I do not know.

FIG. 1. A sugar maple found growing in an open pasture. The annual rings indicated an age of about 25 years. The maximum height was 45 cm. This tree appeared to be vigorous in every way and well able to maintain itself in this miniature form in spite of the cattle.

There is of course considerable variation in the relative abundance of the different species in the different pastures. But considering

the region as a whole the haws are the most conspicuous, not only because their striking contours but because of their number and size as well. Wild apples are frequently associated with the haws and resemble them so closely in form that the two species might easily be confused on superficial observation. Elms are very common in some pastures, but owing to the small size which they are able to attain they are inconspicuous, and would

FIG. 2. A haw in the second or spheroidal stage. This particular individual was 1.5 m. high and 2 m. in the greatest diameter. Though its age was not ascertained, other trees in the corresponding stage showed annual rings indicating an age of 10 to 20 years.

often escape the notice of the casual observer. The oaks seem to have partially solved the problems set for them by the cattle and by reason of their number and size demand attention. The hickories are, in general, avoided by the cattle and so are usually able to reach maturity when once started—at least so far as the cattle are

concerned. However, when they are attacked they usually succumb when the browsing is severe, but if the punishment is not too great they respond in a manner similar to that to be described for the oaks. Only two or three maples have been found which bear evidence of close cropping, not enough from which to draw conclusions (FIG. 1).

Since the thorns, wild apples, oaks and elms are the most numerous and are able to withstand the severe browsing to which they are subjected they are the most interesting types found. The points which I have considered are the forms taken by the several

FIG. 3. The third stage, an erect cone, of the haw. This one was 1.65 m. high and 1.8 m. in diameter at the base. The age might be anywhere from 10 or 20 years up.

species in response to browsing, and the means by which each finally gets beyond the reach of the cattle and so becomes independent.

The ability to withstand constant browsing is only one factor in determining the number of individuals of a species found in a

given pasture. The quantity of seed, the suitability of seed bed and soil, together with other conditions of growth, are quite as important.

The earliest form assumed by the haws as a direct result of the browsing is that of an inverted cone. This particular shape seems to result from the fact that when the tip of a branch is clipped off three or four buds situated short distances below the wound usually start to grow. These buds give rise to branches which elongate at about equal rates, each spreading somewhat from the old axis. Since the cattle trim all the axes which reach the surface and since the branches have a general tendency to grow upwards the plant assumes the form of an inverted cone. Gradually the lower branches are forced downward by the constantly increasing number of new axes formed so that a spheroidal shape may be assumed as shown in FIG. 2. When the lower branches are forced parallel to the ground the tree takes the form of an erect cone (FIG. 3). In grazing the cattle rarely bite the new growth back quite to the dead tips of the older branches, so that there is a gradual increase in size. The conical shape is maintained until the tree is of such a diameter that the center or apex is no longer reached by the cattle. The shoots which are now put out at the apex are free to grow without molestation. The exact duration of the cone stage depends upon the severity of the punishment to which the trees are subjected. In some pastures where the grazing is not severe there may be few or no cones found. In others which are pastured very closely practically all of the haws and apples present are in this condition or show distinct evidence of having passed through it. Under such conditions the plant may be compelled to remain in the cone stage for many years.

When the cattle are no longer able to reach the apex of the cone one or more axes quickly spring out so that we find a closely cropped cone with a loose clump of shoots projecting at its apex. This stage is shown in FIG. 4. In spite of the constant cropping of all new growth within the reach of the cattle, this protected clump rapidly increases both in height and diameter. But since above the reach of the cattle it is free to expand and an hour-glass shape soon results (FIG. 5). Trees in various stages are shown in FIG. 6.

Gradually the free portion of the tree extends beyond the lower branches. The lower portions are now shaded and finally are removed by self pruning until there results the usual rounded

FIG. 4.

FIG. 5.

FIG. 4. This haw had become of so great a diameter that the cattle could no longer reach its apex and so the shoots from this region were able to grow unmolested. This one was 3 m. high and of the same diameter at the base.

FIG. 5. The hour-glass form which is assumed by the haws after the apex has been able to grow for a few years without pruning.

head supported by a single trunk or perhaps by a group of two or three coordinate trunks. However the evidence of the struggle by which the tree has attained its adult shape is seldom quite lost.

FIG. 6. A common sight in pastures whose owner depends upon the cattle rather than the axe.

While the forms taken by the haws are perhaps more striking they are no more characteristic than those assumed by the oaks. Here as a rule only a single axis is developed, from the sides of which short branches are put out. Usually the topmost pair are longer than any of the others or if the browsing is particularly severe there may be a swelling at the top from which several branches arise (FIG. 7). Here the presence of dead stubs, indicating the axes which have been killed by the cattle is a striking feature. The head shown in FIG. 8 is typical of what is usually seen.

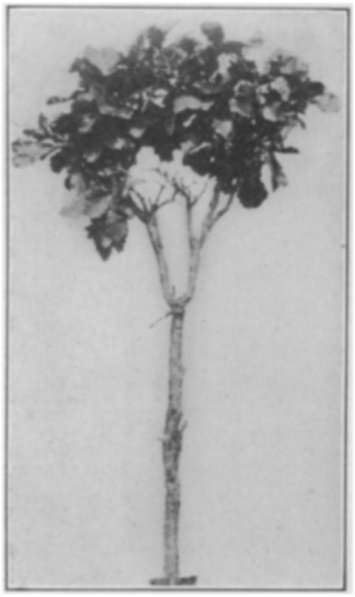

FIG. 7. An oak which represents the form typically assumed by this tree when browsed. This one was 12 years of age and had reached a height of 1.35 m. and a diameter of 0.7 m. There were seven annual rings just below the crotch.

The reason for the difference in habit between the oaks and the haws lies, I believe, in the fact that the oaks throw almost their whole strength of growth into a single bud so that when uninterrupted growth has been permitted by the cattle, even for a short time, some one axis will be seen to be much longer than any of the others. While, as has been shown, the growth of the haws is more diffuse, the number of axes increasing with the removal of each tip and all elongating at an approximately equal rate. As a matter of fact it appears that in general the oaks, when able to reach an independent stage at all, do so in fewer years than the haws. On the other hand the haws are able to stand the more severe punishment.

At times, when the terminal bud is greatly interfered with it may not be possible to identify the dominant axis. Evidence of the general tendency is, however, usually furnished by a study of the growth of successive years. Coupled with the emphasized growth of a single bud is the habit of putting out but few branches in response to the removal of the terminal portion of an axis.

The gnarled and bent forms which result from severe browsing may be converted into straight and erect trunks by a stronger growth over all concave surfaces than is found on the convex exposures. This together with the tendency of the growing points to assume the erect position is sufficient to conceal even such a head as the one shown in FIG. 8. During the process of straightening many of the dead stubs decay and are broken off so that they are overgrown. FIG. 9 shows a longitudinal section through a head similar to that shown in FIG. 7, made after this had long

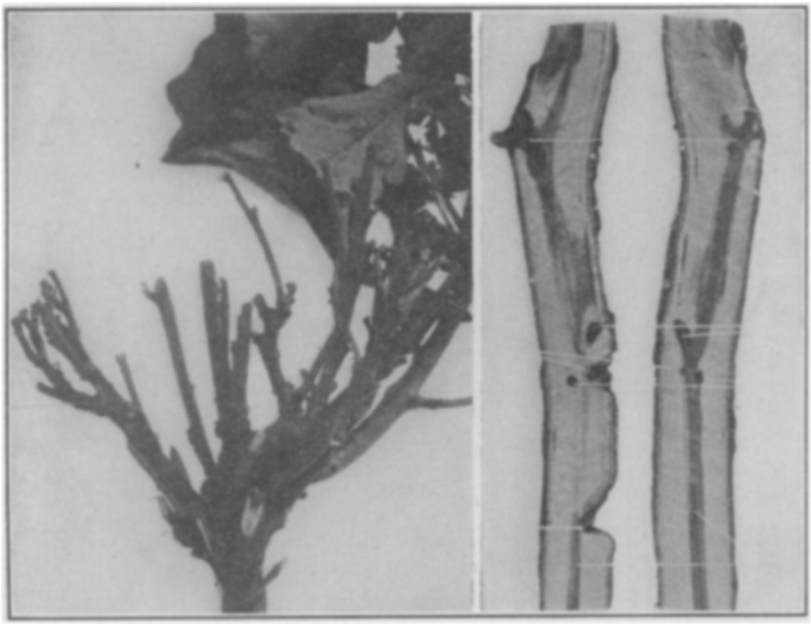

FIG. 8. FIG. 9.

FIG. 8. When the oaks are severely browsed they are frequently unable to maintain a successful growing axis until after many trials. The result is a globular head, from which project many dead and dying spikelike branches. These later drop off or are overgrown as shown in FIG. 9. About one third natural size.

FIG. 9. A longitudinal section through a head such as is shown in FIG. 8. This has long since ceased to be the point of conflict and the bases of the stubs are being overgrown and the stem straightened as described in the text. About one fourth natural size.

since ceased to be the point of contest and after the main axis had crowded all the others out of the field. The same means of

straightening is used by the other forms studied as well as by those oaks in which the grazing has been less severe. In FIG. 10 is shown a longitudinal section through the axis of an oak which has been subjected to severe browsing, but in which no head had been formed.

In walking through the pastures in which elms are common it is noted that almost all of the trees are 30–80 cm. in height.

FIG. 10. Another instance of straightening, but in this case the browsing has not been so severe and there was no head formed. About one fourth natural size.

This is in many cases due to the fact that these trees commonly grow in the midst of sedges and reach about the height of the sedges before they are noticed by the cattle. They usually reach this height in two or three years and after this are not permitted to increase. Finally the upper portion of the stem dies from the continued cropping and a new shoot appears lower down on the axis or even from the roots and, under the protection of the dead or dying top, soon reaches the height of the latter when it in turn is subjected to severe browsing. There first results a form somewhat resembling that assumed by the oaks, a single stem with a number of side branches, FIG. 11. Finally, if the plant has sufficient vigor, a form is assumed resembling the first, or inverted cone stage, of the haws, FIG. 12. This results from branching and

development of shoots low down on the axis. An intermediate stage is shown in FIG. 13. While this shape appears much later in the elms, it is more accentuated and persistent than in the haws. This is because the branches of the elm have a more marked upward tendency and are not so readily induced to hug the ground as are the branches of the apples and haws. This upward tendency of the branches, together with the fact

FIG. 11. FIG. 12.

FIG. 11. This elm was in an early stage of the response to browsing. In spite of its age of 18 years, its height was only 61 cm.

FIG. 12. An elm that had been allowed to grow only 32 cm. in 17 years. The close branching and abundance of dead twigs indicate that it is well along in the inverted cone or second stage.

that an axis dies after certain amount of pruning, precludes the possibility of the formation of the spheroidal or of the erect conical form.

The elms are not in general able to reach the independent stage unaided. This is doubtless because they have the habits of growth of the haw but not the haw's vitality and ability to stand pruning. Though the elms are not able to reach independence unaided it must not be inferred that there are no elms which have obtained the independent stage in the pastures. An elm reaching up through

a clump of wild roses, a haw or a spice bush or even from the center of a group of less fortunate elms is a common sight.

In one plot of about 1.5 hectares sixty elms were counted, all of which were unprotected. Of these 90 per cent., or fifty-four, were less than 80 cm. in height and none were beyond the reach of the cattle. The tallest was 1.5 m. In another plot 50 m. square, 121 elms were found, seventeen of which were either protected at the

FIG. 13. An elm at a stage intermediate between those shown in FIGS. 11 and 12. But since it was growing in the open, i.e., was unprotected by sedges, it was only 20 cm. in height though it was 15 years of age.

time or had been at a time which permitted them to escape from the cattle. Of the 104 which were unprotected only two exceeded 1 m. in height and none were beyond the reach of the cattle. 80 per cent. of all the elms in this plot were below 1 m. in height and 23 per cent. enjoyed protection. In the same plot fifty oaks were found with only 56 per cent. below 1 m. and 12 per cent. unprotected.

SUMMARY AND CONCLUSIONS

1. The haws, apples, oaks, and elms are able to withstand constant browsing by cattle for a prolonged period of time.

2. In general other trees in pastures, as the ash, are killed within a few years; or they are avoided by the cattle, as the hickories and other nut-bearing trees.

3. When the tree is able to withstand the cropping for a long period it has good chances of reaching the natural size of the species. This is attained in different ways by the different species:

(*a*) The oaks throw the stress of growth into a single series of buds and so prolong the main axis at the expense of the lateral branches that the tip of this axis may be lifted beyond the reach of the cattle in comparatively few years.

(*b*) The haws and apples put out a large number of approximately equal branches forming a close network about the center of the tree, which is finally so far removed from the attacks of the cattle that it may grow unmolested. This is a much slower method than the one adopted by the oaks but seems to be somewhat surer as judged by the number of successful individuals.

(*c*) The elms have given up the attempt to reach independence without the help of some other plant but because of their persistence many of them are in time given the necessary protection.

4. While thorns are undoubtedly a factor in the escape of some species from the cattle their importance may easily be overestimated; the apples are apparently quite as successful as are the haws but are not provided with this armament.

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Kerner has described similar observations on the oak and beech but especially on the larch, as browsed by goats. Doubtless many others have observed related phenomena in pastural regions.

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